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PLANT & PEST ADVISORY

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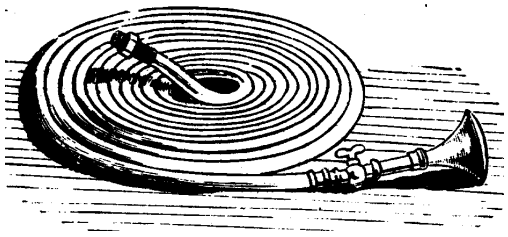

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Managing Dormant Turf

James A. Murphy, Ph.D., Turf Management

Lawns

Letting lawns go dormant should pose little problem if the drought does not go on too long, and the turf is grown on reasonable soil and was properly managed. The longer the dormancy the greater the loss of plants, and the turf will take longer time to recover. Additionally, turf that was allowed to go into dormancy gradually will survive the best. Those lawns that were recently (just before drought stress) fertilized and are grown on soil having poor water holding capacity (sandy or highly compacted) are the most likely to suffer turf loss. Under such conditions the turf has little time to go into dormancy and some plant crowns will actually die before dormancy is achieved.

Property owners should avoid trafficking the turf as it is going dormant (wilting and then turning brown). Excessive traffic on dormant turf should be avoided, some traffic is tolerable. Plan on fertilizing 2 to 3 times once the rains return to encourage recovery from dormancy and any stand loss. Plan on some re-seeding or re-sodding of lawns grown on sandy soil or soils that are severely compacted (this reduces water holding capacity). Kentucky bluegrass and tall fescue lawns will likely survive dormancy the best. Fine fescue may survive well, depending on the incidence of summer patch disease and traffic; fine fescues will suffer extensive damage when trafficked under drought stress. Perennial ryegrass lawns will be very sensitive to drought and thin severely when allowed to go into drought-induced dormancy. Perennial ryegrass lawns grown in full sun and on poor soil will require overseeding for rapid recovery from drought stress damage. Without overseeding weed invasion could be severe during the fall and winter. And if recovery over the fall, winter and spring is slow, crabgrass could be severe in Y2K.

Golf Turf

For golf course superintendents facing water restrictions on fairways they need to consider: soil type, major turf species present, management prior to turning of the water, management during dormancy, and a recovery plan.

Fairways that will not receive irrigation during restrictions will either go into dormancy or die, depending on the above factors. If possible the turf should have been preconditioned for no supplemental irrigation. Preconditioning can be achieved by gradually reducing the available water to the turf (deficit irrigation over a period of many days or a couple weeks). This allows the turf to "prepare" for severe drought stress and go into a dormant state. Preconditioning is "easier" on finer-

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textured soils that have a large water holding capacity; the turf dries out more slowly. Conversely, sandy soils present a greater challenge for preconditioning turf because severe drought stress develops so quickly on these soils, and turf plants (any plants for that matter) have too little time to react physiologically (adapt) to the stress.

Poa annua (annual bluegrass) turfs will be the most susceptible to damage from drought. Many golf course superintendents are managing this highly invasive, weak perennial species on the fairways. The golf courses will likely experience poor recovery once the drought has subsided. Fortunately, or unfortunately, depending on your perspective, annual bluegrass is a prolific seed producer, and the seed bank in the soil of these fairways will contain a sufficient quantity of seed that the annual bluegrass will re-establish from seed. This seed bank presents a challenge to those using the drought damage as an opportunity to introduce better adapted turf species and varieties; the annual bluegrass invasion from seed will frustrate those wishing to change over the fairway species composition to a better adapted species/variety.

Creeping bentgrass will survive dormancy better than annual bluegrass; however, this may not be apparent on sandy soils because of the low water holding capacity that limits the time that creeping bentgrass has to develop a dormant condition. Creeping bentgrass will survive dormancy better on soils that do not dry too quickly.

Perennial ryegrass will be intermediate to annual bluegrass and creeping bentgrass in the ability to survive under no supplemental irrigation. Superintendents should expect severe thinning of perennial ryegrass turf in areas having poor soil quality. Better stand recovery of perennial ryegrass fairways will occur for turfs grown on soils that dried slowly as water was being withheld. Plans should be made to overseed perennial ryegrass fairways once the drought has subsided. Experience with the local conditions will provide a good estimate of the fairway areas that will have the greatest need for overseeding to stimulate rapid recovery.

Preconditioning turf for drought will be difficult on fairways (or roughs) that were fertilized aggressively within one to two weeks of withholding water. The recently fertilized turf has been encouraged to grow which is counter to the objective of inducing dormancy. Thus, managers can anticipate lesser or greater drought damage based on fertilization history.

Mowing height should be raised and the interval between mowings should be lengthened when preconditioning turf for dormancy. Continued frequent, low mowing is detrimental as a turf is being preconditioned for dormancy. Similarly, traffic should be restricted as a fairway turf is wilting and turning brown. Some traffic is tolerable once the turf is dormant, however, extensive traffic should be avoided. More dead turf should be expected if fairway use continues at a high level during the water restriction period.

A turf recovery plan should be devised. A manager should evaluate supplies on-hand including fertilizers (complete/starter) and seed for rejuvenating severely thinned or dead areas and fertilizers. A thorough fertilization program must be initiated once the water restrictions have been lifted to achieve rapid recovery. The drought may present an opportunity for golf courses having fairways comprised of poorly adapted grasses to convert to better grasses. The decision to change turf species requires good planning and should be given careful consideration. This year's preemergence herbicide program should also be evaluated. Long residual herbicide materials may restrict seeding options in a recovery program and inhibit recovery from germinating annual bluegrass seed or new root development from plant crowns.

There are number of issues to consider as water use restrictions are enacted. Hopefully, some of the above is useful as we face the challenges of managing turf during drought. ❑

Yard Waste & Trash Don't Mix

Joseph Heckman, Ph.D., Soil Fertility, Uta Krogmann, Ph.D., Solid Waste Management, Stephanie Hamel, Ph.D. Postdoctoral Research Associate, Lisa Boyles, M.S. Program Associate in Solid Waste Management

What becomes of grass clippings and leaves collected from residential and commercial landscapes? If mulch mowers are available, grass clippings are left on the lawn, which is most beneficial to maintaining a healthy lawn and is the most environmentally sound way to manage grass clippings. About 80% of collected yard waste is recycled in New Jersey. Leaves, and in some counties, grass clippings are banned from landfills. Therefore, collected leaves are mostly composted or directly applied to farmland. Arranging to discard landscaping wastes can occasionally be a problem for landscapers. However, there is an easy way to make the material more desirable for recycling.

Farmers accept grass clippings and leaves for the purpose of increasing soil organic matter and thus improving soil quality. Any trash mixed with yard waste discourages growers from taking it and also complicates composting, due to extra labor and expenses involved with removing bottles, aluminum cans, etc. If landscape professionals carry bags to collect any non-biodegradables and separate garbage from the grass clippings and leaves, they would make their yard waste more acceptable to farmers and composting sites. By placing collected trash and recyclables into the proper waste stream, rather than allowing them to enter farmers' fields or composting facilities, the landscaper reduces the likelihood of damage to equipment and soil, and lowers composting costs. In addition, this will help to foster a good business relationship between landscapers, farmers and composters. ❑

Diseases of Turfgrass

Bruce B. Clarke, Ph.D., Turfgrass Pathology

General

Gray leaf spot, basal stem rot anthracnose, brown patch, and **pythium blight,** continue to be reported. **Summer patch** is prevalent on annual bluegrass, Kentucky bluegrass and fine fescue species. **Dollar spot** is also apparent on golf and landscape turf at this time. Since the latter disease is stimulated by environmental and cultural stress, maintain optimum turf vigor to reduce disease incidence. For best results, irrigate between midnight and 8 a.m. to avoid drought stress. Refer to recent issues of this newsletter for additional disease control information.

Basal Stem Rot Anthracnose

This disease, caused by the fungus *Colletotrichum graminicola*, is apparent on bentgrass, annual bluegrass, fine fescue, perennial ryegrass, and Kentucky bluegrass at this time. The fungus typically attacks turf growing under low soil fertility and/or heat and drought stress. Low cutting height can also enhance symptom development. To identify **anthracnose** in the field, look for small black fruiting bodies with protruding black spines. For best results, increase turf vigor with light applications of nitrogen, maintain adequate irrigation, reduce thatch, and raise the cutting height (when possible). Apply Banner, Bayleton, Cleary 3336, Daconil, Eagle, Fungo, Heritage, Manicure, Rubigan, Sentinel, or Thalonil on a preventive basis, per manufacturer's recommendations. Once the disease develops, good results have been obtained with a tank mix combination of Bayleton 50DF (1 oz/1000 ft^2)+ Daconil Ultrex 82.5 WDG (2.8 to 5.5 oz / 1000 ft^2) or Cleary 3336 50W (4 to 6 oz) + Daconil Ultrex 82.5 WDG (2.8 to 5.5 oz/1000 ft^2). Avoid the use of ProStar on turf infested with anthracnose since this product has been shown to enhance this disease when conditions are conducive for disease development.

Gray Leaf Spot

Gray leaf spot, caused by the fungus *Pyricularia grisea*, has begun to develop on several golf course fairways in central and southern New Jersey recently. This disease devastated perennial ryegrass and tall fescue plantings throughout the Mid-Atlantic states during late-summer and early fall in 1998. Due to similar environmental conditions this year, we may see a resurgence of this disease during the next few weeks. Symptoms start as tiny, brown leaf and stem lesions covering 1 to 2 inch spots. In severe cases, the leaves curl and lesions may extend the entire width of the blade. As the disease progresses, patches coalesce into large (one to two feet) areas of blighted turf. Extensive foliar blighting may occur during warm (75-85°F), wet weather. Newly established seedings are more susceptible to infection than mature plantings. When conditions are conducive to infection, the pathogen produces abundant one to two-celled, pear-shaped spores (conidia). For best results, avoid high rates of nitrogen during July and August and extended periods of leaf wetness (i.e. water in the early morning hours). Fungicide studies conducted in New Jersey, Georgia, Maryland, and Kentucky have shown that Heritage (0.2 to 0.4 oz/1000 ft^2) and Cleary 3336 50W (6 to 8 oz/1000 ft^2) were most effective when applied on a preventive basis every 14 to 28 days beginning in mid to late-July. Chlorothalonil (e.g., Daconil) and the DMI (sterol-inhibiting) fungicides, such as Banner (propiconazole), have also provided effective control when disease pressure was moderate.

Marasmius

There have been numerous reports recently about the appearance of small mushrooms protruding from brown leaf blades. These structures, belonging to the fungus *Marasmius*, are approximately 1/2 to 3/4 inch in length, and consist of a dark brown stem and a small tan to orange colored cap. **Marasmius** often appears in areas that have been thinned by brown patch. Although this fungus may appear to be pathogenic, it is actually invading dead and dying tissue and thus is not a threat to the surrounding turf.

Summer Patch

This disease, caused by the root-infecting fungus *Magnaporthe poae*, is prevalent on annual bluegrass, Kentucky bluegrass, and fine fescue turf throughout the state. For those turf managers who are on a preventive spray program, now is the time to apply the third and perhaps final fungicide application for the control of **summer patch**. For optimum results, apply Banner, Bayleton, Cleary 3336, Eagle, Fungo, Heritage, Rubigan, or Sentinel, in 4 to 5 gal of water/1000 ft^2 If fungicides cannot be applied with this much water, irrigate them into the thatch immediately with 1/16 to 1/8 inch of water. Aerification and improved drainage will also aid in disease suppression. Soil pH should be maintained at or slightly below 6.0 for best results.

Yellow Tuft

This disease, caused by the fungus *Sclerophthora macrospora*, is present on greens and irrigated landscape turf at this time. **Yellow tuft** (=Downy Mildew) occurs on almost all cool-season turfgrasses; however, it is usually only a serious problem on turf maintained at a low cutting height. Poorly drained or heavily irrigated sites are often associated with disease development. Infected turf appears stunted, off color (yellow to light green), and may exhibit slightly broadened leaf blades and dense clusters of shoots. Patches range in size from 1/4 to 1 inch in diameter for bentgrass and red fescue turfs, and 1 to 3 inches for bluegrass and perennial ryegrass areas. Tufts are easily removed from the soil due to the absence of adventitious roots. To control, improve drainage, avoid overwatering, mow only when the grass is dry, apply iron sulfate to mask symptom expression, and spray turf with Aliette, Prodigy, or Subdue on a preventive basis (next spring) at 21 day intervals from late March to early June. ❑

Current Greenhouse Flower Pests & Disorders

Jim Willmott, Camden County Agricultural Agent

✔ **Black root rot** caused by *Thiclaviopsis basicola* has been troublesome on **fall pansies**. Growers should monitor crops closely for symptoms that first resemble a nutritional deficiency or stunting. Overwatering and inappropriate nutrient management may increase problems to the point where roots turn black and rot. Diseased plants are difficult to cure so early detection and roguing are essential. For pansies, maintain media pH between at about 5.5. This is lower than most crops, but is necessary for reducing disease problems. Fungicides are labeled and effective when problems are caught early.

✔ **Fungus gnats** continue to trouble growers. **Poinsettias** are most vulnerable during propagation when cuttings can be lost. Remember feeding is not the only risk, fungus gnats spread root disease pathogens.

✔ **Fusarium wilt** has been diagnosed on **garden mums** in containers and in a field planting. Wilting and scorching were noted along with discoloration of the xylem tissue. Some plants had pink-orange sporodochia (spore masses) along infected stems. Damaged plants should be discarded. Thiophanate fungicides may limit disease development and spread, but will not cure damaged plants. Nitrate sources of nitrogen are recommended to suppress disease development.

✔ **Marginal Leaf Necrosis (Burn) on Poinsettias** Last year growers in the Northeast reported marginal leaf burn on poinsettias. Adept, an insect growth regulator used to control fungus gnats, was implicated in several cases. Injury symptoms occurred 4 or more weeks after application. Uniroyal, the manufacturer, removed poinsettias from the Adept label this year. However, many growers still have Adept from last season that permitted use on poinsettias. According to the old Adept label, it may injure poinsettias if misapplied. Application instructions are very specific and emphasize the importance of precise application rates and frequency. *Note that the label states:*

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Plant Diagnostic Laboratory Highlights

Richard Buckley, Laboratory Coordinator

Turfgrass

Turfgrasses continued to take a beating in the region in the first part of August. Golf turf submissions came at a record pace through the 6th, but have slowed with a little bit of cooler weather and a drop of rain. Obviously, *Poa annua* is in the most trouble and on many golf greens the grass continues to decline for no particular reason except that it is *Poa annua* and it is mid-summer. Sometimes it is hard to see the forest through the trees! Water management is playing a critical role at this point. Most *Poa* has literally no root system left and needs constant syringing to keep it alive. Regular irrigation provides plenty of moisture that cannot be taken up by a plant with 1/8th-inch roots; therefore, we are seeing lots of turf with **anaerobic soil**, **algae blooms**, **black layer**, secondary ***Pythium*** problems, or **anthracnose**. Further complicating things was the recent change in the weather. A reduction in humidity, coupled with a gentle breeze would increase the transpiration needs of a plant that just can't supply itself with the moisture needed to keep up. Don't worry, the heat will be back!

As far as disease is concerned, **anthracnose** and **pythium blight** appears to be the most common submissions from golf courses. **Brown patch** is also quite common at this time. Most of the samples with **brown patch** have been coming from residential landscape turf. We are also seeing a lot of **summer patch** samples. The **summer patch** is predominately from Kentucky bluegrass lawns, but has begun to show up on Kentucky bluegrass rough areas on golf courses. After last season's **gray leaf spot** fiasco, some turf managers decided to renovate fairways and rough areas with Kentucky bluegrass. Wasn't **summer patch** one of the reasons we went to perennial ryegrasses?

We finally have confirmation of **gray leaf spot** from a golf course. Last Friday the laboratory identified the fungus in a sample from a perennial ryegrass fairway that was sent from Virginia. Dr. Pete Dernoden of the University of Maryland informed us that he diagnosed the disease on a golf course near Baltimore. **Gray leaf spot** is also increasing in severity on the research plots here in North Brunswick. If you haven't started a preventive fungicide program, now would be the time. The August forecast calls for normal rainfall amounts, which should increase disease pressure. If you have significant turf loss due to heat, drought, and water restrictions remember **gray leaf spot** is an excellent damping-off disease. During your renovation, if you use perennial ryegrass, be sure to protect the seedlings with fungicides.

Landscape

Pachysandra is a candidate for the *troubled plant of the year* in the landscape. **Pachysandra canker and blight** is almost a daily submission to the laboratory. We are also seeing large populations of **two-spotted mites** on most of the recent pachysandra samples. **Two-spotted mites** were also identified on weeping cherry from a landscape in Somerset County. Impatiens and marigold samples from residential landscape in Cape May and Middlesex Counties were diagnosed with **pythium crown and root rot**. No doubt the disease was severe in these plantings because of the extra water needed to keep them going in the heat. **Rhizoctonia crown and root rot** was also diagnosed on impatiens from Middlesex County. Finally, samples of elm with excellent **Dutch elm disease** symptoms continue to be submitted from trees in the Princeton area. ❑

Phytophthora Root Rot – a Troublesome Disease during NJ Summers

Ann B. Gould, Ph.D., Plant Pathology

Phytophthora root rot in ornamental nursery crops is a problem growers face in the summer when temperatures are warm and container stock remains wet or does not drain properly for extended periods of time. This disease, one of the most common diseases of nursery crops, is caused by several species of the water mold fungus *Phytophthora*. One species, *P. cinnamomi*, is troublesome in nearly 1000 plant hosts, many of which are nursery crops grown in New Jersey. The fungus is most commonly associated with azalea and rhododendron, but also causes a diseases in hosts such as arborvitae, blueberry, camellia, chamaecyparis, daphne, dogwood, forsythia, Frasier fir, heath, heather, hemlock, Japanese holly, juniper, kalmia, pieris, pine, pittosporum, stewartia, white pine, and yew.

Symptoms

Phytophthora is a soilborne fungus that attacks the roots of susceptible plants. In the early stages of infection, plants become stunted and turn a dull-yellow color. Affected leaves wilt, rolling inward along the major vein axis as they droop. Frequently, plants wilt during the heat of the day and recover at night. Under more severe conditions, shoot tips and major branches die, leading to eventual death of the plant. The root systems of plants infected by *P. cinnamomi* turn dark brown, become brittle, and die. Dark, reddish-brown to brown streaks typically extend up into the wood just beneath the bark at the soil-line, a symptom that is diagnostic for the identification of this disease.

Disease Development

P. cinnamomi survives within infected root and crown tissue and in host debris. The fungus does not tolerate freezing and rarely survives in soil in the absence of host tissue. When soil moisture is high, the fungus produces fruiting structures called sporangia that release zoospores. These motile spores, attracted by root exudates to healthy roots, germinate on root surfaces and invade root tissues. The infection spreads, and affected root cells die. Once a substantial portion of the root system is killed, foliar symptoms develop.

Impact of Moisture and Temperature on Disease Development

Phytophthora root rot is favored by high soil moisture and can be severe when plants are grown in wet, poorly drained soils or mixes. Production and dispersal of sporangia and zoospores are enhanced in water-saturated soil. It takes only a few days for roots to become infected and produce new spores, so the disease can increase dramatically if infested soil becomes water logged.

High temperatures (75 to 80°F) also favor disease development. Although strains of the fungus will vary, the minimum and maximum temperatures at which *P. cinnamomi* will grow and reproduce are 40 to 60°F and 85 to 95°F, respectively. The temperature of container media during the growing season is frequently higher than that of surrounding soil. Field grown stock, therefore, may not exhibit symptoms of the disease, even in the presence of the fungal pathogen. Furthermore, container stock infected by the fungus at low temperatures early in the growing season may not develop obvious symptoms of the disease until media temperatures increase later in the summer or plants are subjected to environmental stresses.

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"drench volumes recommended are less than those commonly used for application of other soil pesticides, as the volume of final solution applied need only be enough to wet the top 2 inches of potting media. *Exceeding label rates, volumes and number of applications may result in injury, especially to poinsettias...*"

✔ **Pythium root rot** was diagnosed on **garden mums** and **lavender**. *Pythium* infections are favored by overwatering and high media salts, which may result from excessive fertilizer rates or quick release of controlled release fertilizers during hot weather.

✔ **Slow crop growth:** Many growers report slow growth of **fall garden mums** and **flowering kale**. Plants appear healthy with good color. This is most likely due to high day and night temperatures and high humidity. During periods of excessive heat and humidity plant physiological processes slow or stop. Expect growth to accelerate with warm days and cool nights.

✔ **Thrips** were less troubling this past spring, but don't let your guard down! In Southern New Jersey and other areas, limited precipitation has promoted high populations of thrips including **Western flower thrips** outdoors. Heavy outdoor populations have been attributed to mild winter weather, limited precipitation, excessive weed populations and warm temperatures. Thrips pose a significant risk to fall crops and should be monitored now!

✔ **Wildlife pests**– especially deer heartily consumed field grown herbaceous ornamentals. Critters also ravaged many gardens already sparse from lingering drought. Encourage gardeners to fill voids with hardy fall plants. Traditional garden mums remain popular, but interest in pansies and flowering kale continues to grow. Many growers were successful last year with Proven Winner's Fall Magic plants.

✔ **Xanthamonas Blight on zonal geraniums: Xanthamonas** has been discovered on geraniums being grown for stock this summer in greenhouses in both Pennsylvania and Ohio, sadly we are seeing symptoms in the Landisville variety trials as well. *(Source: Alan Michael, Capital Region Greenhouse News, August 9, 1999, Penn State Cooperative Extension)* ❑

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Disease Management

P. cinnamomi is very difficult to eradicate once established. Successful disease management, therefore, requires an approach that utilizes preventive cultural practices.

◆ Use only pathogen-free stock. Purchase only healthy, vigorous stock, and inspect these plants carefully for signs of disease. Imported stock should be segregated in the nursery for several months to be sure the plants are free of disease. Propagate only from cuttings taken from disease-free mother plants.

◆ Plant only in pathogen-free soil or potting mix. Since Phytophthora root rot is easily spread through the movement of infested soil, all potting mix components should be steam-pasteurized before use. Once pasteurized, mix components should not come into contact with fresh soil or plant debris. In the propagation house, containers should be new or surface-sterilized before use. All propagation tools, benches, and beds should also be surface-sterilized. In field sites with a history of this disease, an appropriate chemical fumigant should be applied before planting.

◆ Select well-drained potting mixes and field sites. Phytophthora root rot tends to be more severe in container plants than in the field because over-watering is a frequent problem and mix temperatures tend to be higher. The disease can also be a problem when soil, peat moss, or sawdust is used as the sole component of the container mix. A mix high in sawdust is more conducive to disease development because drainage is poorer. A good potting medium should generally contain 20 to 25% air-filled pore space. When used as a potting mix amendment, composted hardwood bark inhibits disease development.

To prevent the dispersal of spores of *P. cinnamomi* through splashing in the nursery, place container plants on a well-drained base, such as three to four inches of gravel. Container beds should be graded to allow water to drain away from the pots and prevent puddling. In the field, select planting sites that are most appropriate for vigorous growth.

◆ Maintain plant vigor. Maintain proper levels of soil nutrients, moisture, and soil pH. Avoid over-watering and cultural practices that promote overly succulent growth, such as heavy fertilization, over-crowding, and low light. Succulent plants and those under stress are more susceptible to disease.

◆ Utilize disease resistant plants and cultivars when possible. Many well-known azalea and rhododendron hybrids are very susceptible to Phytophthora root rot. Under severe environmental stress, however, even tolerant cultivars may succumb to this disease.

◆ Apply an appropriate fungicide when necessary. Fungicides such as Banrot, etridiazole, fosetyl-Al, mefenoxam, metalaxyl, or propamocarb-HCl are useful when applied as a preventive drench per manufacturer's recommendations. Once plants become infected, fungicides may arrest further infection but do not kill the fungi within infected roots and soil. Although fungicides are useful for disease control, they cannot replace good cultural practices. ❑

Pest Notes

Deborah Smith-Fiola, Ocean County Agricultural Agent, and Steven Rettke, Program Associate in IPM

✔ **DROUGHT:** Trees are negatively affected by both short-term and long-term drought. Short term drought lasts for a single growing season of moisture stress. It will create problems for sensitive tree species such as birch, fir, hemlock, spruce and scarlet oak. Long term drought is the result of more than one growing season of moisture stress. This accumulated effect is the most important for tree health, and symptoms are often confused with other ailments.

Weeks or months may go by before a plant exhibits long-term drought symptoms. Leaves may appear normal, even while the moisture deficit is causing extensive root injury in late summer and fall. Visible symptoms may not appear until the following spring, or even *years later*. The most common symptom is dieback of the upper branches from the tips back. Progressively, larger branches die as the stress continues. Annual growth is reduced as the tree continues to decline. Weak, dying trees are readily colonized by bores, bark beetles, and canker fungi.

Control of drought-stressed trees after-the-fact is difficult. Install an irrigation system, preferably a drip system (1 inch of water/week is equivalent to putting 40 gallons of water for a 10-foot diameter tree). Start watering 10 days after the last substantial rainfall. Water deeply and infrequently. If a tree must be replaced, select a drought-tolerant species (many native trees are adapted to low water conditions).

Drought stress shuts down the vascular system of affected plants. Leaf feeding insects thrive under drought stress because many of the plants' defensive chemicals ("semiochemicals") are not produced. These defensive semiochemicals are present in healthy plants, but under stress the available energy is used for survival, and defense is a lower priority. When defensive semiochemicals are limited, pests can feed with little resistance. Most borers, for example, often target drought-stressed trees and then successfully feed within branches and trunks, because of the lack of sap or pitch production.

✔ **OZONE DAMAGE:** Of the various air pollutant classes, ozone is the most damaging to plants. Ozone is a secondary pollutant generated by the combined reaction of ultraviolet light, oxygen and oxides of nitrogen. Ozone is most commonly phytotoxic to plants in urban areas during warm, sunny weather (i.e., mid-summer). Ozone causes symptoms on sensitive trees when daytime average atmospheric concentrations in summer often exceed 0.05 ppm.

Ozone causes sensitive plant cell membranes to collapse. These collapsed cells often occur in clusters on the foliage, and appear as white to tan flecks or dark stipples. Sometimes an accumulation of dark pigment precedes or accompanies the cell collapse.

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The landscape plants in our area most likely to show effects from this air pollutant are some of our pine species (especially eastern white pine). There are two distinct symptoms on needles that ozone injury produces. One symptom is a mottling of chlorotic spots with diffuse margins that form irregularly along nearly the entire length of needles that are more than a year old. The other typical symptom causes a tip necrosis on the current year needle growth. During the needle elongation period, the mid tissue area along the needle length is most sensitive. This intermediate aged needle tissue collapses initially, and then the outer needle tips follow soon after. Eventually the entire affected needles may turn brown, but the early symptoms are tiny bleached flecks and pinkish yellow spots along the lines of stomata.

When minor ozone injuries occur during the growing season, the damage may be intensified during the winter from drying and freeze-thaw stresses. Furthermore, dormant pines are generally tolerant to polluted air. Examine the stomata-free side of the needle to help separate ozone damage from other winter type injuries. If only symptoms are present on the side of the needle where stomata are present, then it is likely that the damage was from ozone or some other air pollutant (magnification is recommended). (*Ref: Sinclair, et al, Diseases of Trees and Shrubs)*

✔ **TULIPTREE APHID:** This host-specific insect feeds on tulip poplar, and occasionally on magnolia. There are several generations per season, and active aphids may be present much of the growing season. Look at the underside of leaves for the yellowish aphids. High populations can produce copious amounts of honeydew and sooty mold. Although the health of infested plants are rarely threatened; leaves may turn yellow, be reduced in size, and drop prematurely.

If honeydew accumulations become a problem during the summer, use horticultural soaps or oils to control and conserve beneficials (parasitoids and predators alone may not be effective for total population control). If the black overwintering eggs are present on twigs in the off-season, then a dormant oil spray is appropriate.

✔ **WHITEFLIES:** The three species commonly found within the landscape are azalea, mulberry and maple whiteflies. The azalea and maple whiteflies feed only on the hosts which bear their names, while the mulberry species feed upon holly, mountain laurel, magnolia, maple and mulberry.

Adults are white, 1/16 to 1/8 inch in length, and resemble tiny moths. When the plant is disturbed, large numbers of adults fly up in a "white cloud" before settling back down on the plant to feed. Nymph and pupa stages are flat and resemble scale insects. All stages feed on the underside of leaves.

Heavy infestations may cause leaves to wilt, turn yellow and drop prematurely. Lower leaves first become covered with honeydew, followed by sooty mold.

Numerous ants present on the foliage may also indicate a population of whiteflies (they feed on the honeydew). Control is often not needed, as damage is often insignificant. Rake up and destroy fallen leaves. If sooty mold and damage are significant, spray the undersides of infested leaves with insecticidal soap or horticultural oil. Parasitoids and predators often maintain these pests at minimal levels.

✔ **GREEN JUNE BEETLE:** In August, the differences between the Green June Beetle and other white grubs commonly found feeding on turf roots is not pronounced. However, in September, many white grubs molt for the second and final time to become mature 3rd instar larvae. The Japanese, Oriental, and Masked Chafer beetles, for example, will typically increase their size during the second molt from approximately 0.7 to 1.0 inches in length. The Green June Beetle larvae, however, will nearly triple in size, increasing their length from a 0.75 inch-second instar to 2.0 inch-third instar larvae.

When the Green June Beetle larvae reach the mature third instar stage, they also begin to change their movement patterns to crawl along the soil surface on their backs during the night. Larvae can migrate as much as 40 to 60 feet during a single evening.

These distinctive larvae damage turf by their burrowing and tunneling activities. They disrupt the surface soil, loosen roots, and feed on roots and crowns. Unless the turf is extensively irrigated, the grass plants will wilt and die. Larvae also feed on decaying organic matter in thatch and root zones. Top dressed lawns (because of the resulting increased organic matter) are attractive to the egg laying adults. The adults can also cause damage when they burrow into the soil at night during the summer.

Controls: **Scoliid Wasps** are beneficial insects that fly in groups just above the surface during August and into September. This species of digger wasps parasitize the grubs of Green June Beetles. When the number of grubs per square foot exceeds 5 to 6, then chemical controls may be necessary. Granular materials are typically more effective than liquid formulations. Sevin G, and Diazinon G have both proven to be effective as controls.

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